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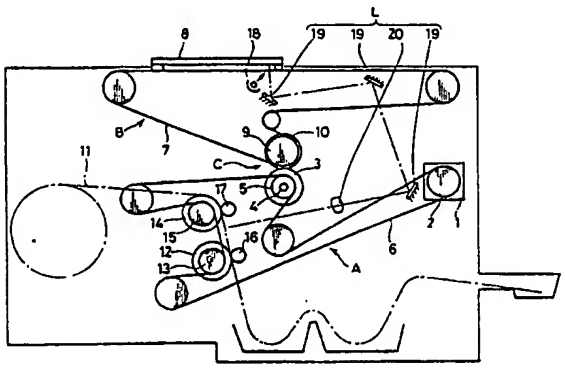
(54) Synchronous driving apparatus for a scanning exposure type reproducing apparatus.

(57) A synchronous driving apparatus for a scanning exposure type reproducing apparatus comprises: a feeding roller formed of rubber for feeding an image recording sheet; a pressing roller formed of rubber for pressing the image recording sheet onto the feeding roller; a first steel belt for rotating the feeding roller through a pulley; an input roller formed of rubber rotated by the first steel belt through the pulley; an output roller formed of stainless steel provided rotatably so as to be in contact with the input roller; a second steel belt moving in synchronization with the rotation of the output roller through a pulley fixed on the same axis as the output roller; and an original holding frame fixed on the second steel belt for holding the original, moved in a prescribed direction for scanning. The ratio of the change of the frictional force due to the change of the temperature between the input roller formed of rubber and the output roller formed of stainless steel is the same as the ratio of the change of the frictional force between the image recording sheet and the feeding roller formed of rubber.

FIG.3



Synchronous Driving Apparatus for a Scanning Exposure Type Reproducing Apparatus

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a scanning exposure type reproducing apparatus such as a reproducing camera, an electrophotographic copying machine and the like, and more specifically to a synchronizing apparatus, that is, a synchronous driving apparatus for synchronously moving either an original holding frame or an optical system with an image recording sheet in the scanning exposure type reproducing apparatus.

Description of the Prior Art

A synchronous driving apparatus for feeding image recording sheets for the scanning exposure type reproducing apparatus of particular interest to the present invention is disclosed in, for example, Japanese Utility Model Laying-Open Gazette No. 81648/1986. Fig. 1 is a cross sectional view showing the synchronous driving apparatus disclosed therein and Fig. 2 is a perspective view showing the main portion thereof.

Referring to Figs. 1 and 2, a conventional synchronous driving apparatus comprises an endless steel belt 52 fixed to an original holding frame 51 and moves accompanying the movement of the frame, a driving pulley 53 wound by the endless steel belt 52 for driving a driving roller 54, a driving roller 54 provided coaxially with the driving pulley for rotating a feeding roller 56, a feeding roller 56 for feeding an image recording sheet 55, and for feeding pressing roller 57 for pressing the image recording sheet onto the feeding roller 56.

A conventional synchronous driving apparatus is structured as described above in order to form an image on an image recording sheet in synchronization with the scanning of the image. Namely, if the scanning and the movement of the image recording sheet are not carried out at the same speed, the image on the image recording sheet would be skewed. In order to prevent the skew of the image, the synchronous driving apparatus is carefully structured as will be described in the following. The driving pulley 53 and the driving roller 54 are made of materials having the same expansion coefficient and they have the same diameter. Therefore, even if the temperature changes, the diameters of the driving pulley 53 and the driving roller 54 will be the same, so that the speed of rotation thereof is the same. Consequently, there will be no difference between the moving speed of the original holding frame 51 and the feeding speed of the image recording sheet 55, which will be otherwise caused by the thermal expansion derived from the change of the temperature.

In the conventional synchronous driving apparatus, the synchronization of the rotation of the feeding roller and the movement of the original holding frame can be maintained even if the temperature is changed. However, even if the synchronization is maintained, the quality of the reproduced and recorded image is degraded in some cases. The reason is as follows. Since the feeding pressing roller formed of rubber presses the image recording sheet 55 on the feeding roller 54, the moving speed of the feeding roller 56 and image recording sheet 55 is theoretically the same. However, when the temperature is changed, the hardness of the rubber forming the feeding roller 56 varies, and the volume thereof expands or contracts. Consequently, the diameter of the feeding roller 56 changes, causing the change of the coefficient of friction between the roller and the image recording sheet 55. Therefore, the frictional force between the image recording sheet 55 and the feeding roller 56 fluctuates. Consequently, even if the driving pulley 53 is rotated at a constant speed, the image recording sheet 55 is not moved at the constant speed.

SUMMARY OF THE INVENTION

Therefore, one of object of the present invention is to provide a synchronous driving apparatus for a scanning exposure type reproducing apparatus in which the quality of the image is not degraded.

Another object of the present invention is to provide a synchronous driving apparatus for a scanning exposure type reproducing apparatus in which the image on an image recording sheet is not skewed.

A further object of the present invention is to provide a synchronous driving apparatus for a scanning exposure type reproducing apparatus in which the image recording sheet material and the original holding frame are fed synchronously.

A still further object of the present invention is to provide a synchronous driving apparatus for a scanning exposure type reproducing apparatus in which the image recording sheet material and the

original holding frame are moved synchronously even if the temperature is changed.

A still further object of the present invention is to provide a synchronous driving apparatus for a scanning exposure type reproducing apparatus having a simple structure in which the quality of the image is not degraded.

The above described objects of the present invention can be attained by generating the same slip as the slip between the feeding roller and image recording sheet at the time of moving the original holding frame and the like when the temperature is changed. If the slip between the feeding roller and the image recording sheet is generated when the original holding frame is moved, the original holding frame also slips by the same amount of the slip of the image recording sheet. Therefore, the moving speed of the image recording sheet will be the same as the moving speed of the original feeding frame. Consequently, the quality of the image on the image recording sheet is not degraded.

According to a preferred embodiment of the present invention, the synchronizing apparatus for a scanning exposure type reproducing apparatus comprises: first roller means for winding and feeding an image recording sheet with a frictional force between the first roller means and the image recording sheet having a prescribed fluctuation characteristics dependent on the temperature; second roller means operatively coupled to the first roller means, with the frictional force having the same fluctuation characteristics as the prescribed fluctuation characteristics of the frictional force; and a scan moving portion for moving the original or an optical system for scanning in synchronization with the rotation of the second roller means.

Since the synchronous driving apparatus for a scanning exposure type reproducing apparatus comprises the above described components, the change of the coefficient of friction between the first and second roller means dependent on the temperature coincides with the change of the coefficient of friction between the image recording sheet and the first roller means. Therefore, the ratio of the change of the coefficient of friction generated between the two by the change of the temperature is the same, causing the same amount of slip. Consequently, the image on the image recording sheet do not skew.

According to a more preferred embodiment of the present invention, the first roller means is directly in contact with the second roller means, the first roller means having at least the surface thereof formed of an elastic material, and the second roller means having at least the surface thereof formed of stainless steel.

Since the synchronous driving apparatus for a scanning exposure type reproducing apparatus comprises the above described components, the apparatus can be structured with a small number of rollers and simple materials. Consequently, a synchronous driving apparatus for scanning exposure type reproducing apparatus having a simple structure and capable of preventing degradation of image quality can be provided.

These objects and other objects, features, aspects and advantages of the present invention will become more apparent from the following detailed description of the present invention when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a cross sectional view showing a conventional synchronous driving apparatus for a scanning exposure type reproducing apparatus;

Fig. 2 is a perspective view showing the main portion of Fig. 1;

Fig. 3 is a schematic cross sectional view of a direct plate reproducing camera;

Fig. 4 is a perspective view showing the main portion of Fig. 3; and

Figs. 5 to 7 are schematic diagrams showing other embodiments of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Fig. 3 is a schematic cross sectional view of a direct plate making apparatus which is an example of the scanning exposure type reproducing apparatus. Fig. 4 is a perspective view of the main portion thereof. The direct plate making apparatus comprises a driving system A for feeding an image recording sheet 11, a scanning system B for scanning an original, and a power transmitting mechanism C for transmitting power from the driving system A to the scanning system B.

The driving system A comprises: a motor 1 containing a reducer; a driving pulley 2 attached to the motor 1; an input roller 3 made of rubber constituting a portion of the power transmitting mechanism; a transmission pulley 5 fixed to a supporting axis of the input roller 3; a feeding roller 12 for feeding the image recording sheet 11; an image recording sheet tensing roller 14 for applying tension onto the image recording sheet 11; pressing rollers 16 and 17 provided for preventing slip of the image recording sheet 11 on the feeding roller 12 and on the image recording sheet tensing roller 14; a feeding pulley 15 for driving the feeding roller 12; a tensing pulley 13 for driving the image recording sheet tensing roller 14; and a steel belt 6

for transmitting power to the driving pulley 2, the driven pulley 5, the feedlng pulley 15 and the tensing pulley 13.

The scanning system B comprises: an original holding frame 8 for holding an original; an optical system L for scanning and exposing the original holding frame 8; an endless steel belt 7 for moving the original holding frame 8 for scanning; a driving pulley 9 wound by the endless steel belt 7 for moving the endless steel belt; and an output roller 10 provided coaxially with the driving pulley 9 for rotating the driving pulley 9.

The power transmitting mechanism C is constituted by a portion of the scanning system B and a portion of the driving system A, comprising: an input pulley 3 rotated by a driven pulley 5 which is rotated by the steel belt 6; and an output roller 10 rotating in contact with the input pulley 3 for driving the endless steel belt 7 through the drlving pulley 9.

The operation will be described in the following.

A steel belt 6 constituting the driving system A is wound around a feeding side pulley 13 arranged on a support axis of a feeding roller 12 for feeding the image recording sheet 11, an image recording sheet material tensing side pulley 15 arranged on a support axis of the image recording sheet material tensing roller 14, a driven pulley 5 fixed on a support axis of the input roller 3, and so on. Therefore, when the motor 1 is driven, the feeding roller 12, the sheet material tensing roller 14 and the input roller 3 are rotated. When the input roller 3 is rotated, the output roller 10 is also rotated, accordingly the driving pulley 9 fixed on the support axis of the output roller is rotated, and the endless steel belt 7 is rotated. Consequently, the original holding frame 8 fixed to the endless steel belt 7 is moved.

In the above described manner, the feeding roller 12 and the original holding frame 8 are synchronously driven by a single motor 1.

Pressing rollers 16 and 17 are in pressure contact with the peripheral surfaces of the feeding roller 12 and the image recording sheet material tensing roller 14, respectively. The image recording sheet material 11 is fed by the rotation of the feeding roller 12, being pressed onto the feeding roller 12 and onto the image recording sheet material tensing roller 14 by pressing rollers 16 and 17. The feeding roller 12 and the image recording sheet material tensing roller 14 are formed of rubber, and the pressing rollers 16 and 17 are formed of stainless steel.

The reason why the present invention is structured as described above will be hereinafter described.

The disadvantages of the prior art are caused by the following reasons. Namely, the coefficient of friction between the image recording sheet and feeding roller formed of rubber fluctuates as the temperature changes. Therefore, even if the feeding roller is rotated at a constant speed, the image recording sheet is not fed at the same speed. Meanwhile, the original holding frame is moved at the same speed as the rotation speed of the feeding roller. Consequently, the original holding frame and the image recording sheet are not moved synchronously.

Therefore, in the present invention, the apparatus is structured such that the fluctuation of the coefficient of friction derived from the change of the temperature between the feeding roller of rubber and the image recording sheet is also generated when the original holding frame is moved. More specifically, in the present invention, the same fluctuation of the coefficient of friction is generated at the above described power transmitting mechanism C.

In order to understand the present invention more clearly, the above mentioned relation will be described in detail with reference to Fig. 4. The image recording sheet 11 is fed by the feeding roller 12 and the pressing roller 16. On this occasion, the coefficient of friction between the image recording sheet 11 and the feeding roller 12 and the like fluctuates according to the change of the temperature. Therefore, the moving speed of the image recording sheet 11 is not coincide with the moving speed of the steel belt 6. Meanwhile, in the power transmitting mechanism C, the driven pulley 5 is rotated at the same speed as the moving speed of the steel belt. Therefore, the input roller 3 fixed on the same axis also rotates at the same speed. The input roller 3 is formed of the same rubber material as the feeding roller 12 and is rotatably in contact with the output roller 10 made of stainless steel. The stainless steel is selected as the material of the output roller 10 from the following reason. Generally, at least the surface of the output roller 10 must be formed of the same material as the image recording sheet 11 in order to present the same state as the feeding roller portion. However, since the image recording sheet 11 is a paper and the like, it cannot be used as the surface of the roller. Theoretically, any material can be employed provided that the coefficient of friction thereof with the rubber roller changes in the same manner as the image recording sheet 11. It is found that the stainless steel is the most preferable material satisfying the above described condition from various experiments.

One of the input roller and output roller should be made of rubber and the other one should be made of stainless steel. Any material can be employed provided that it presents the same frictional characteristics as the image recording sheet.

Fig. 5 is a schematic diagram showing a modification of the present invention, in which the feeding roller 12 also serves as the input roller 3.

Fig. 6 shows the present invention applied to a variable magnification type copying apparatus, comprising two motors 1a and 1b capable of synchronous operation. In this apparatus, provided are a feeding side driving system Aa in which a pulley 2a driven by the motor 1a and a feeding pulley 13 is cooperatively coupled by an endless belt 21; a scanning moving side driving system Ab in which a pulley 2b driven by the other motor 1b and a driving pulley 5 are cooperatively coupled by an endless belt; a scanning moving system B having an endless belt on which an original holding frame 8 is fixed cooperatively coupled with the scanning moving side driving system Ab and through a power transmitting mechanism C by roller contact.

Although description was given of a case in which the original holding frame 8 is moved for scanning in association with a fixed optical system L in each of the above embodiments, the present invention can be also applied to apparatuses in which the optical system L is moved for scanning in association with the fixed original holding frame 8, as in another embodiment of the present invention shown in Fig. 7.

In Fig. 7, the numeral 22 denotes a scanning moving member which supports the optical system L, 23 denotes a first mirror fixed on the scanning moving member, and 24 denotes a second mirror, with the optical system L driven between the position shown by the solid line 7 and the position of a phantom line. The second mirror 24 moves integrally with a moving pulley 26 which is surrounded by a belt 25 having one end supported by the scanning moving member 22 and the other end supported by the body of the image copying apparatus, and the mirror moves for scanning in a stroke shorter than the scanning moving member 22.

In the present invention, one of the input roller and the output roller is formed of a material such as stainless steel having the same fluctuation characteristics of the coefficient of friction in association with the change of the temperature as the image recording sheet, and the other of the input roller and the output roller is formed of rubber. The output roller is driven through the input roller, so that the change of the frictional force, which is the same as the change of the frictional force caused by the change of the temperature between the feeding roller and the image recording sheet, is generated between the output roller and the input roller rotating in synchronization with the feeding roller which is the source of driving for moving the scanning moving member including the original holding frame. Therefore, even if the rotational speed of the feeding roller and the travel speed of the image recording sheet differs from each other due to the change of the frictional force caused by the temperature difference, the travel speed of the scanning moving member also changes accordingly by the same amount. The travel speed of the image recording sheet material and that of the scanning moving member is exactly in synchronization with each other. Consequently, a synchronous driving apparatus for a scanning exposure type reproducing apparatus can be provided in which the quality of image is not degraded even if the temperature is changed.

Although the present invention has been described and illustrated in detail, it is clearly understood that the same is by way of illustration and example only and is not to be taken by way of limitation, the spirit and scope of the present invention being limited only by the terms of the appended claims.

The features disclosed in the foregoing description, in the claims and/or in the accompanying drawings may, both separately and in any combination thereof, be material for realising the invention in diverse forms thereof.

Claims

1. A synchronous driving apparatus for a scanning exposure type reproducing apparatus in which an image of an original is optically exposed and recorded on an image recording sheet by scanning the original through an optical system, comprising:
first roller means for winding and feeding said image recording sheet, with a frictional force between said first roller means and said image recording sheet having a prescribed fluctuation characteristics;
second roller means operatively coupled to said first roller means, with the frictional force having the same fluctuation characteristics as said prescribed fluctuation characteristics; and
a scanning moving portion for moving said original or the optical system for said scanning in synchronization with rotation of said second roller means; whereby
said image recording sheet and said scanning moving portion are moved in synchronization with each other independently from an influence of a change of temperature.

2. A synchronous driving apparatus for a scanning exposure type reproducing apparatus according to claim 1, wherein said first roller means is directly in contact with said second roller means.

3. A synchronous driving apparatus for a scanning exposure type reproducing apparatus according to claim 2, wherein at least a surface of said first roller means is formed of an elastic material.

4. A synchronous driving apparatus for a scanning exposure type reproducing apparatus according to claim 3, wherein at least a surface of said second roller means is formed of stainless steel.

5. A synchronous driving apparatus for a scanning exposure type reproducing apparatus according to claim 4, wherein said elastic material comprises rubber.

6. A synchronous driving apparatus for a scanning exposure type reproducing apparatus according to claim 1, wherein
said first roller means and said second roller means are provided separately;
said synchronous driving apparatus further comprises third roller means rotated in synchronization with said first roller means, and
said second roller means is in contact with said third roller means.

7. A synchronous driving apparatus for a scanning exposure type reproducing apparatus according to claim 6, wherein at least surfaces of said first and third roller means are formed of an elastic material.

8. A synchronous driving apparatus for a scanning exposure type reproducing apparatus according to claim 7, wherein at least a surface of said second roller means is formed of stainless steel.

9. A synchronous driving apparatus for a scanning exposure type reproducing apparatus according to claim 8, wherein said elastic material comprises rubber.

10. A synchronous driving apparatus for a scanning exposure type reproducing apparatus according to claim 6, further comprising one driving source, wherein
said first and third roller means are driven by said driving source.

11. A synchronous driving apparatus for a scanning exposure type reproducing apparatus according to claim 6, further comprising two driving sources, wherein
said first roller means and said third roller means are separately driven by said two driving sources, respectively.

FIG.1

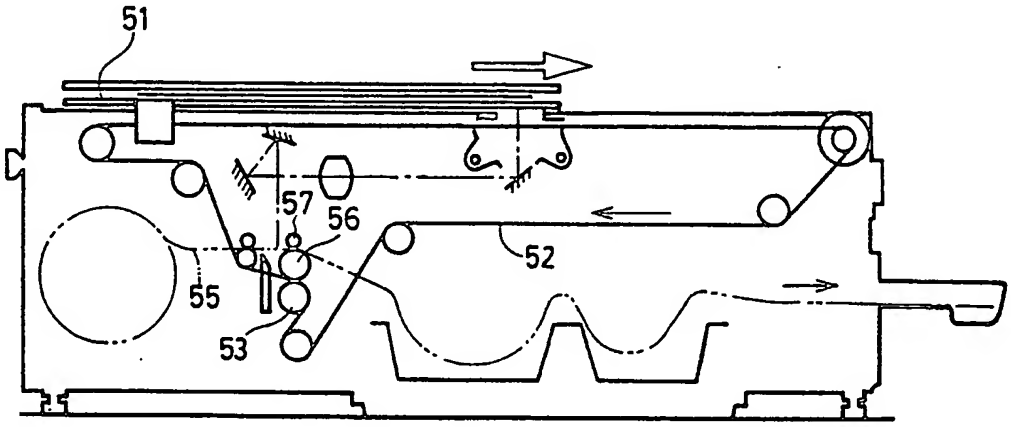


FIG.2

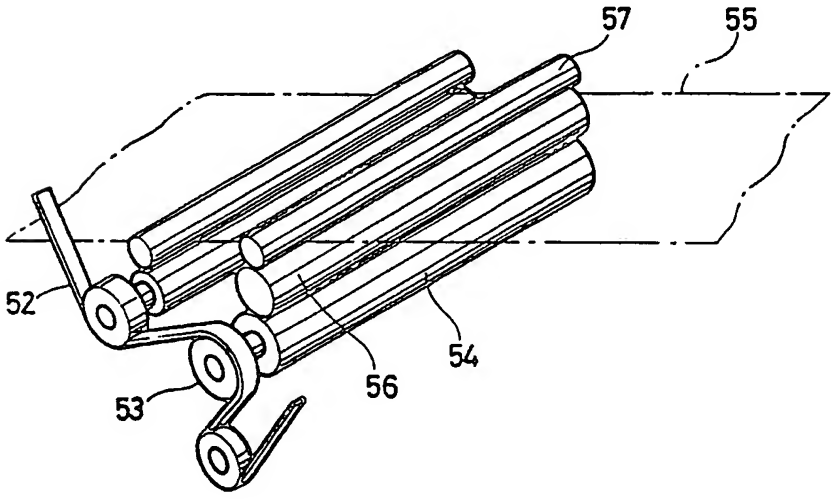


FIG.3

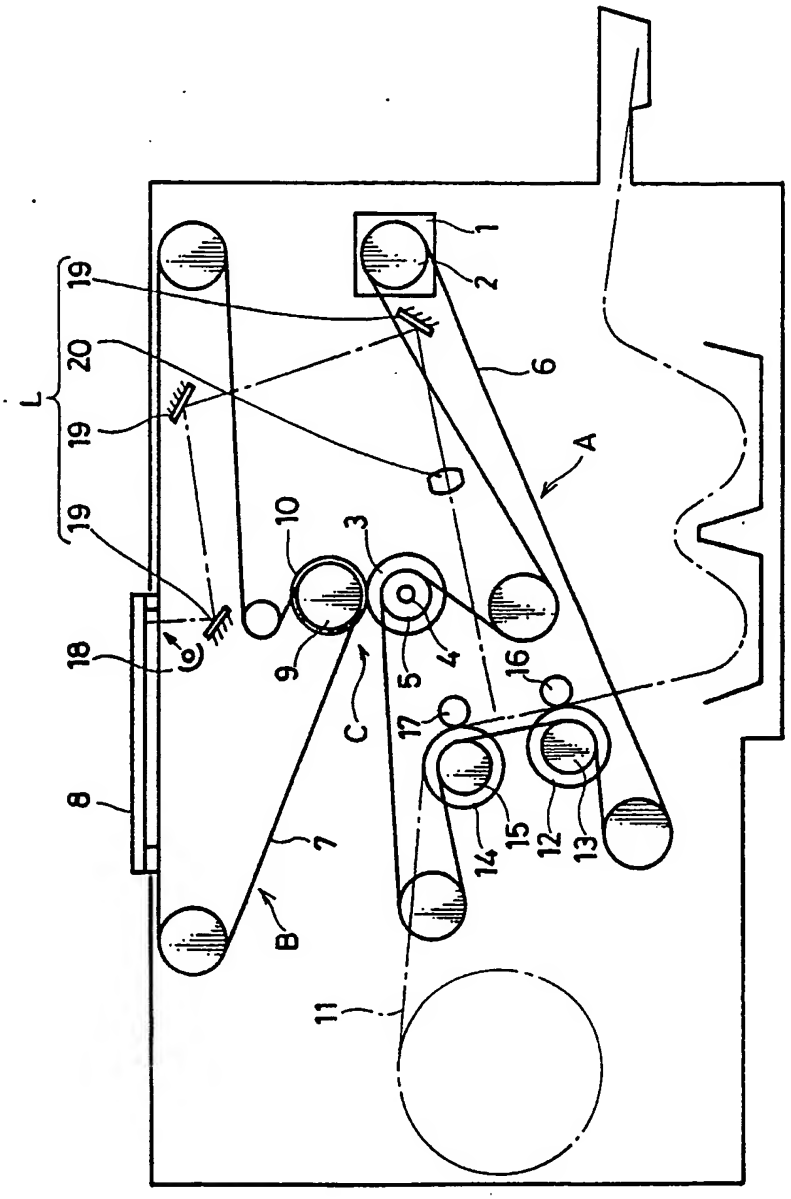


FIG.4

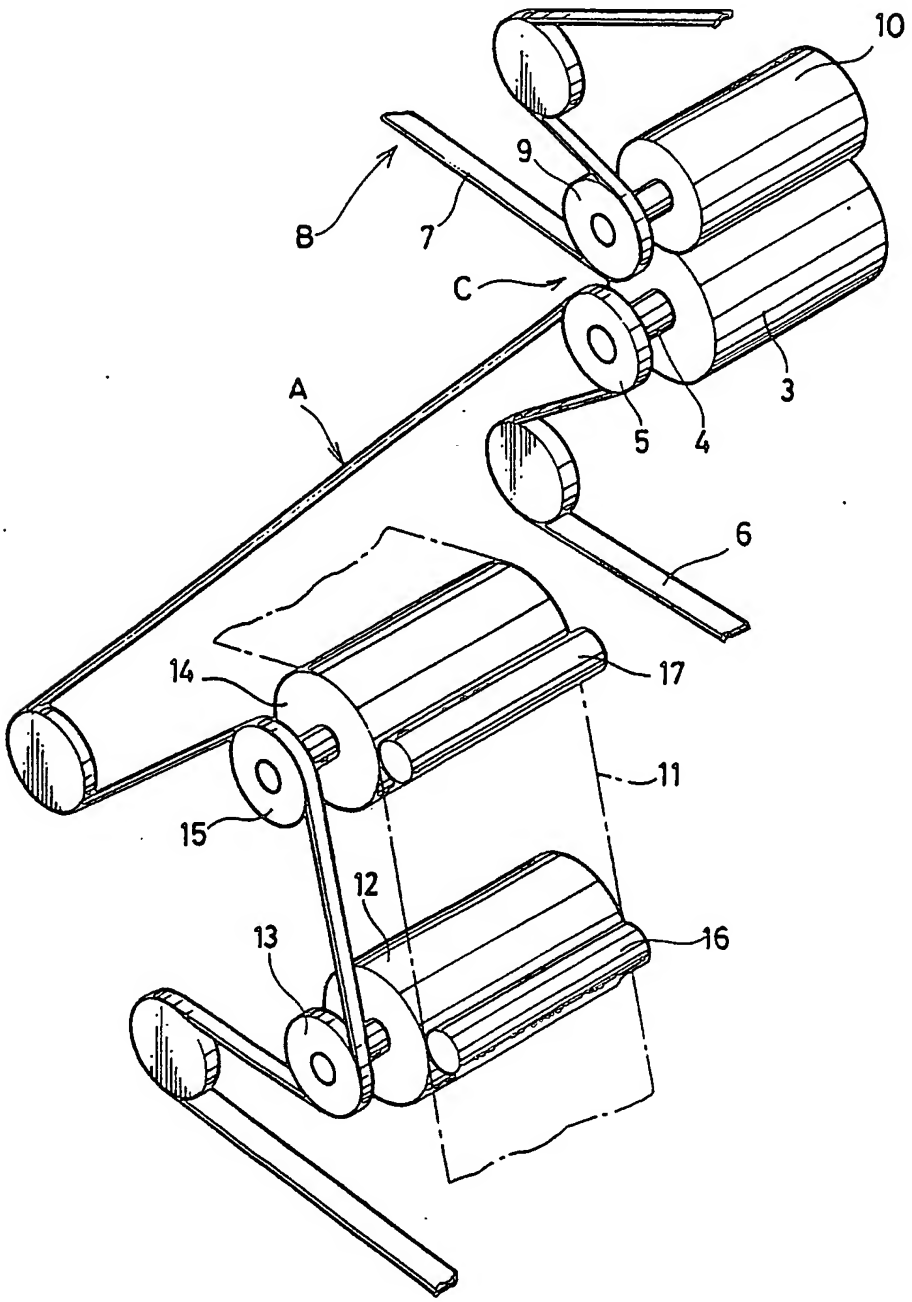
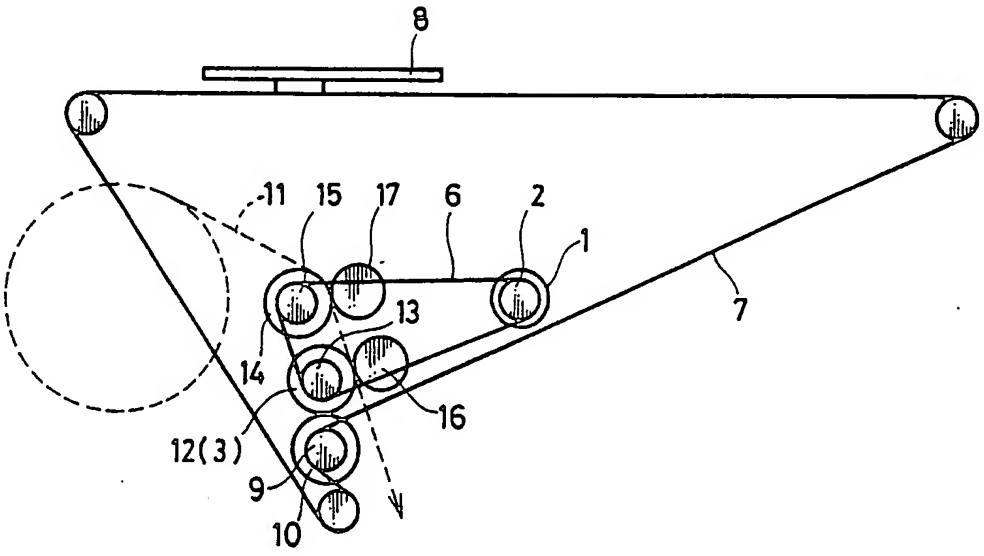


FIG.5


8
11
15
17
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1
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13
14
16
12(3)
9
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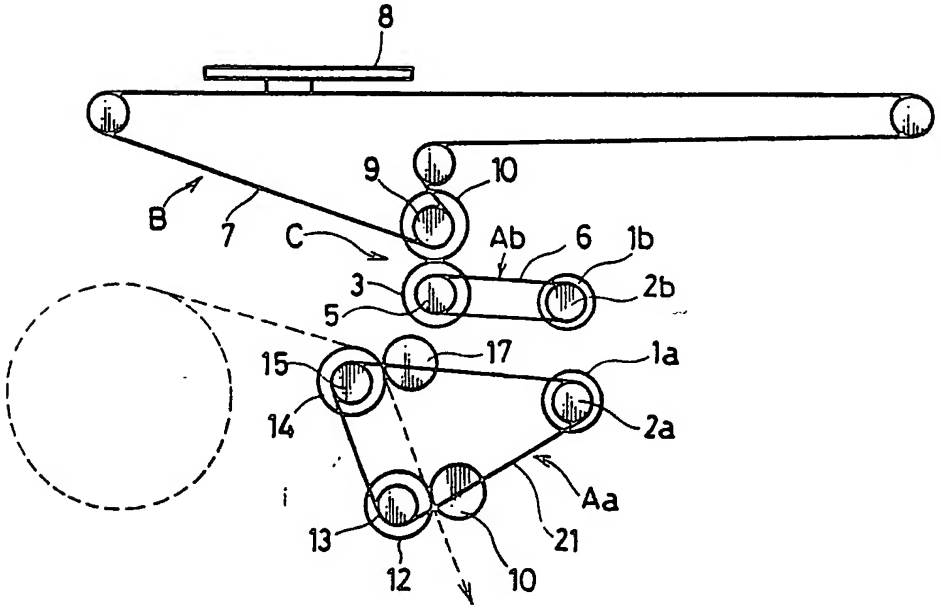
FIG.6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1b
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2b
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2a
Aa
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21
12
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FIG.7